# Bioinformatics
## CS300

## Why Bioinformatics?

**Week 2, deck 2**
**Fall 2022**
**Oliver BONHAM-CARTER**

# An Informatics by Another Name?

- **Bio-medical Informatics**
  - Study population-level data to manage health
- **Clinical informatics**
  - Systems used to deal with patient health
  - Clinical trial management systems, electronic health records, etc.
- **Laboratory information**
  - Systems to deal with scientific instrumentation and data management
  - Connecting instruments together, managing laboratory flow, etc.
- **Bioinformatics**
  - Systems to study DNA to answer questions about disease, relatedness, health and other concepts
  - DNA, RNA, proteins, *molecular* systems by data

# A Current Need For Bioinformatics?

- Vaccine research: reduce the time for development

  "The Impact of Bioinformatics on Vaccine Design and Development", by Ribas-Aparicio *et al.* *link*


**Abstract**

Vaccines are the pharmaceutical products that offer the best cost-benefit ratio in the prevention or treatment of diseases. In that a vaccine is a pharmaceutical product, vaccine development and production are costly and it takes years for this to be accomplished. Several approaches have been applied to reduce the times and costs of vaccine development, mainly focusing on the selection of appropriate antigens or antigenic structures, carriers, and adjuvants. One of these approaches is the incorporation of bioinformatics methods and analyses into vaccine development. This chapter provides an overview of the application of bioinformatics strategies in vaccine design and development, supplying some successful examples of vaccines in which bioinformatics has furnished a cutting edge in their development. Reverse vaccinology, immunoinformatics, and structural vaccinology are described and addressed in the design and development of specific vaccines against infectious diseases caused by bacteria, viruses, and parasites. These include some emerging or re-emerging infectious diseases, as well as therapeutic vaccines to fight cancer, allergies, and substance abuse, which have been facilitated and improved by using bioinformatics tools or which are under development based on bioinformatics strategies.



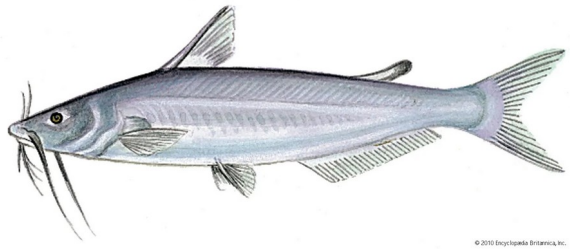
**Keywords:** reverse vaccinology, immunoinformatics, structural vaccinology, computational strategies, vaccine



# Medical

- Disease control: What's making a patient sick
- Avoidance: Better decisions after information of high risks of types of disorders
  - Diabetes, cancer, other disorders
- Research: To process the health data that *already exists*.
  - Open health article (towardsdatascience.com) link
  - What can we learn from our experiments? Past experiments? Can this data train future models?
  - For instance, could we make computer models from data of animal models? (no more animal models?)

# Study of Relatedness



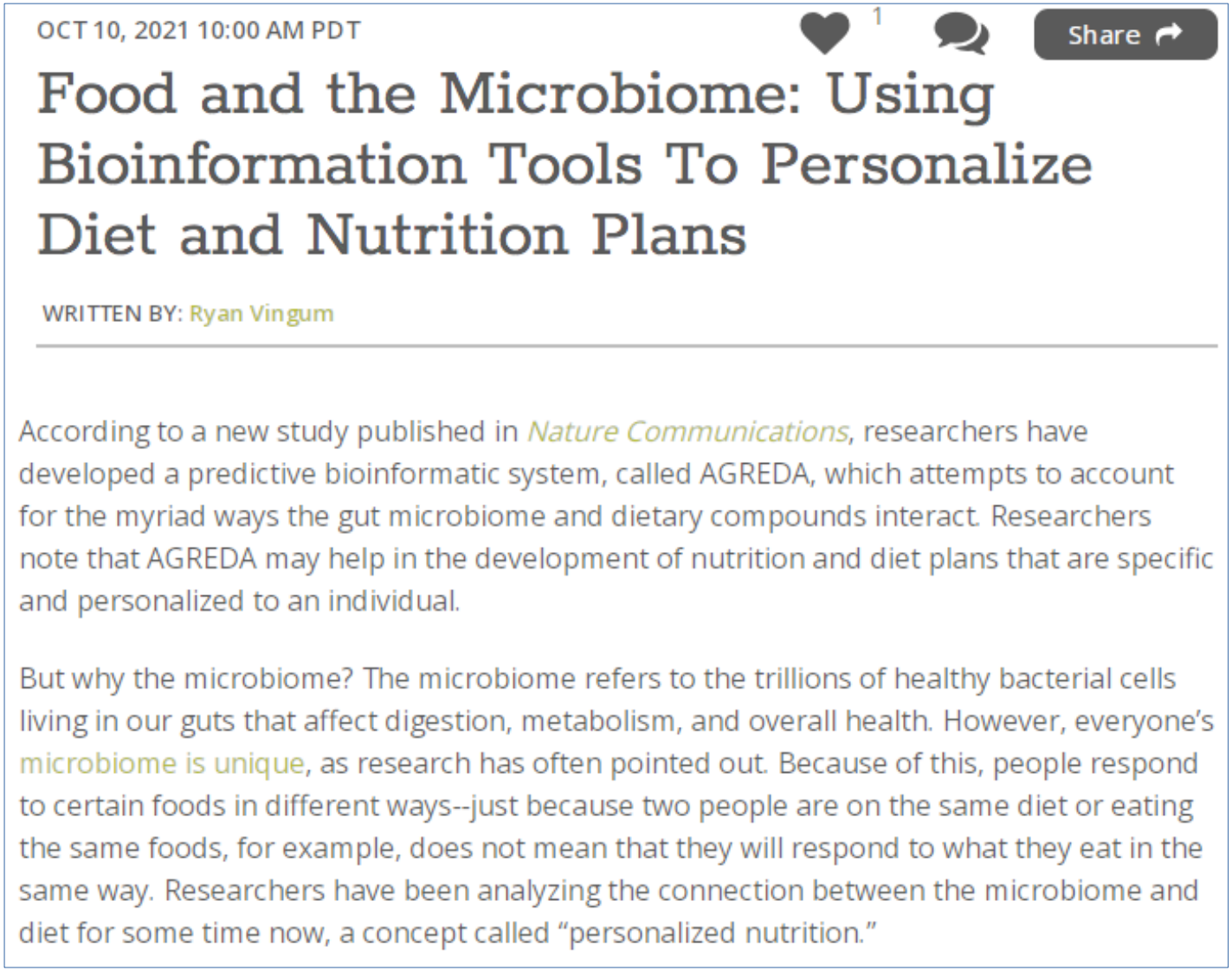
**Fish with 'human' teeth caught in North Carolina**

ref: https://www.bbc.com/news/world-us-canada-58105044

**What is this species of fish?!**

# Nutrition studies

URL



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Share

## Food and the Microbiome: Using Bioinformation Tools To Personalize Diet and Nutrition Plans

WRITTEN BY: Ryan Vingum

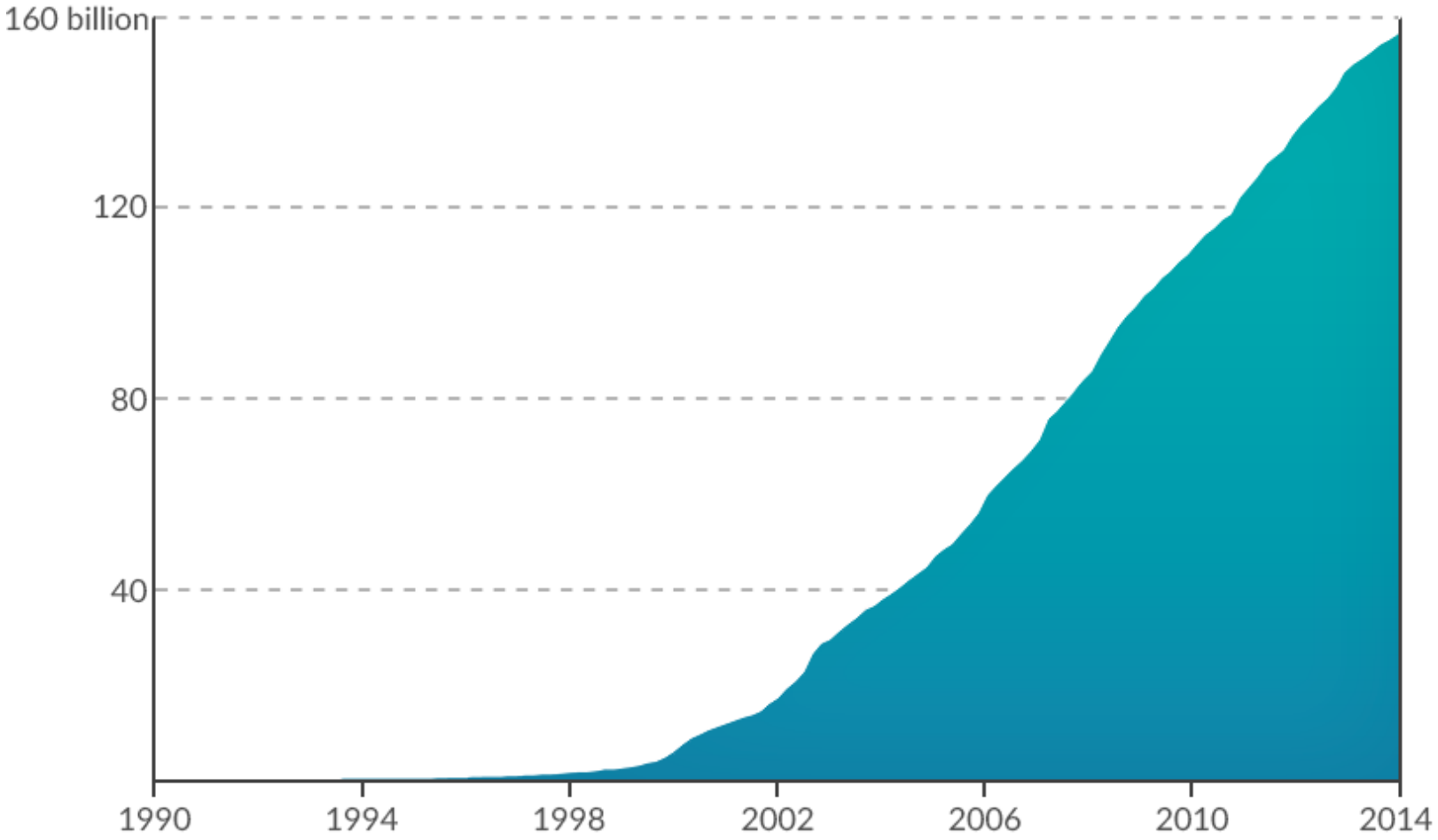
According to a new study published in *Nature Communications*, researchers have developed a predictive bioinformatic system, called AGREDA, which attempts to account for the myriad ways the gut microbiome and dietary compounds interact. Researchers note that AGREDA may help in the development of nutrition and diet plans that are specific and personalized to an individual.

But why the microbiome? The microbiome refers to the trillions of healthy bacterial cells living in our guts that affect digestion, metabolism, and overall health. However, everyone's microbiome is unique, as research has often pointed out. Because of this, people respond to certain foods in different ways--just because two people are on the same diet or eating the same foods, for example, does not mean that they will respond to what they eat in the same way. Researchers have been analyzing the connection between the microbiome and diet for some time now, a concept called "personalized nutrition."

Ref: https://www.labroots.com/trending/technology/21438/food-microbiome-using-bioinformation-personalize-diet-nutrition-plans

# Lots of Data to Process

- Exponential Growth of NIH base pairs through December 2013



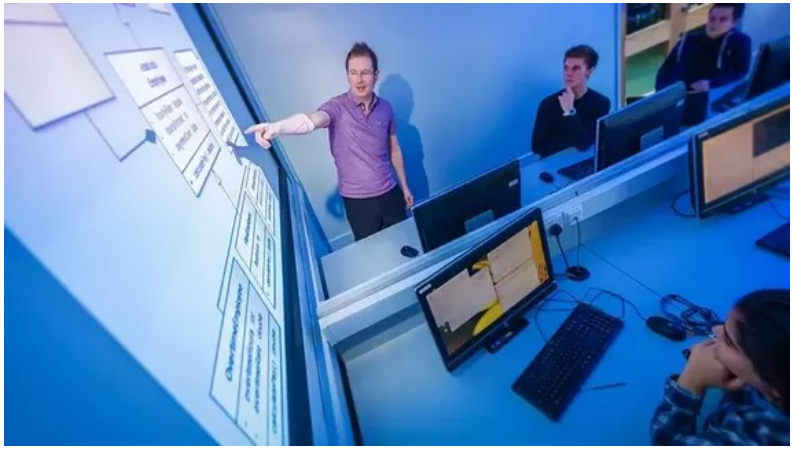
# Needed for Careers?

- Biologists will need
  - Programming skills
  - Mathematical /statistical skill
  - Programming for Automation
  - Skills to manage data
  - Others


- Computer Scientists will need
  - Biology knowledge
  - Knowledge of biological systems and mechanisms
  - Skills to build models after biological systems
  - Others

# Career Ideas

- Professional search link
- Software (bioinformatics) engineer
- Research scientist in biotechnology
- Data scientist
- Project manager (pharmaceuticals, medical, etc)
- Computational immunologist
- Medical doctor (in clinical and research applications)



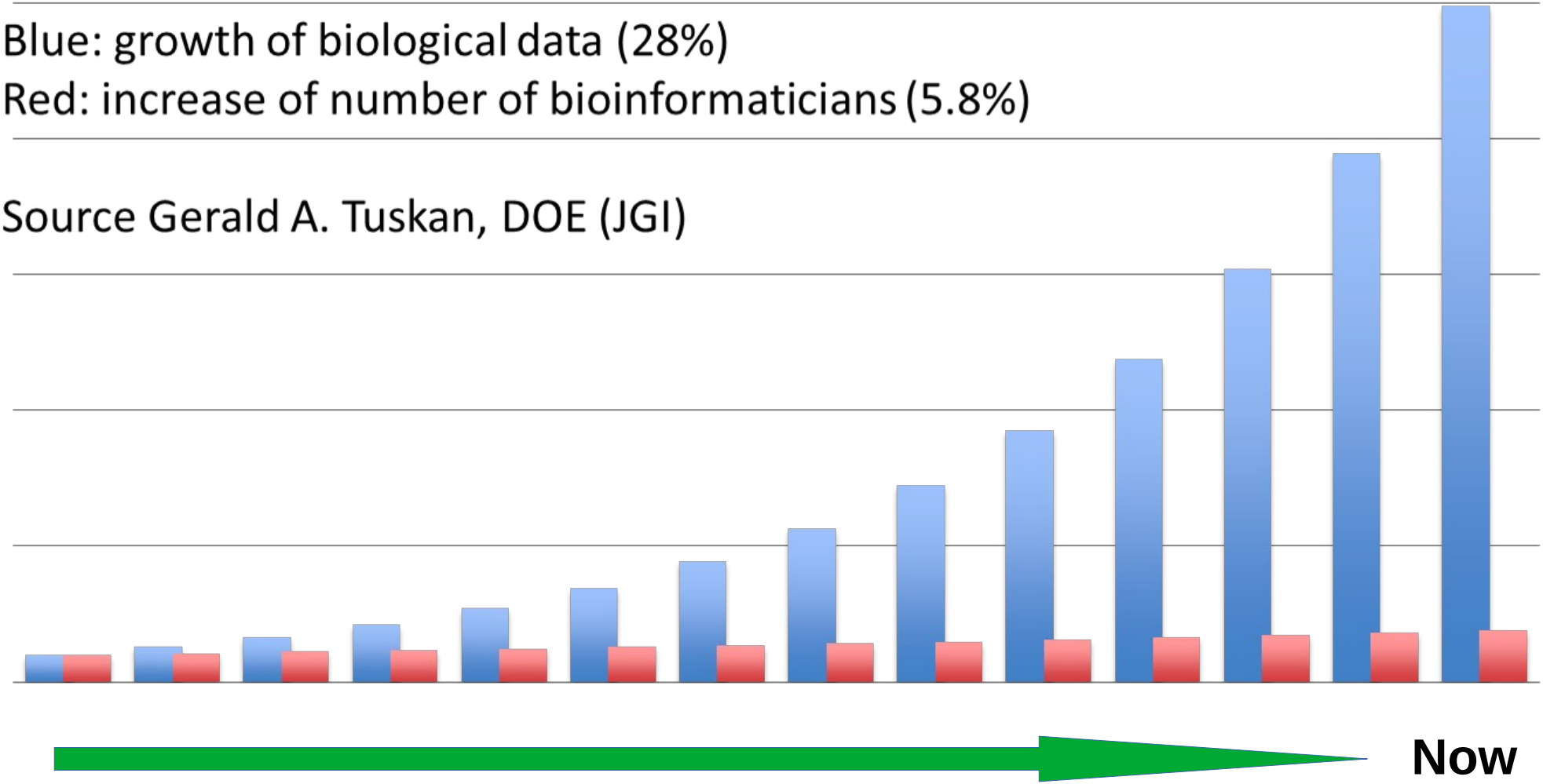
# They Need You Out There!

ALLEGHENY COLLEGE

NEED FOR BIOINFORMATICIANS

Blue: growth of biological data (28%)
Red: increase of number of bioinformaticians (5.8%)

Source Gerald A. Tuskan, DOE (JGI)



# Researchers and Scientists

Bioinformatics Scientists are generally graduate-educated research scientists whose work involves the development of computer and technology-aided solutions to problems in biochemistry and biological research.

Primary focus areas may include genomics and proteomics.These professionals may be required to create, maintain and utilize databases of complex biodata,and utilize exsiting publicly available databases containing similar information.

Go online to read more about careers!
https://www.recruiter.com/salaries/bioinformatics-scientists-salary/

# Job Listings

28 Feb 2021

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glassdoor | Jobs | Company Reviews | Salaries | Interviews | Salary Calculator | Sign In | Write Review | For Employ

Bioinformatics Scientist | Jobs | Location

All Job Types | Posted Any Time | $11K-$217K | 25 Miles | More

Most Relevant — 1365 Bioinformatics Scientist Jobs

GRAIL
**Bioinformatics Scientist**
Menlo Park, CA
$99K - $160K (Glassdoor est.) — Hiring Surge — 11d
4.0 ★

NeoGenomics Laboratories
**Bioinformatics Scientist**
Fort Myers, FL
$65K - $107K (Glassdoor est.) — Actively Hiring — 11d
4.1 ★

GSK
**Clinical Bioinformatics Investigator (Oncology)**
Waltham, MA
$52K - $95K (Glassdoor est.) — New — 3d
4.0 ★

New England Biolabs
**Research Scientist I, RNA Division**
Ipswich, MA
$51K - $97K (Glassdoor est.) — Hot — 4d
4.9 ★

GRAIL 4.0 ★
**Bioinformatics Scientist**
Menlo Park, CA
$99K - $160K (Glassdoor est.)

Apply Now

Hiring Surge — This company is in a hiring surge in response to COVID-19

**Rating Highlights**

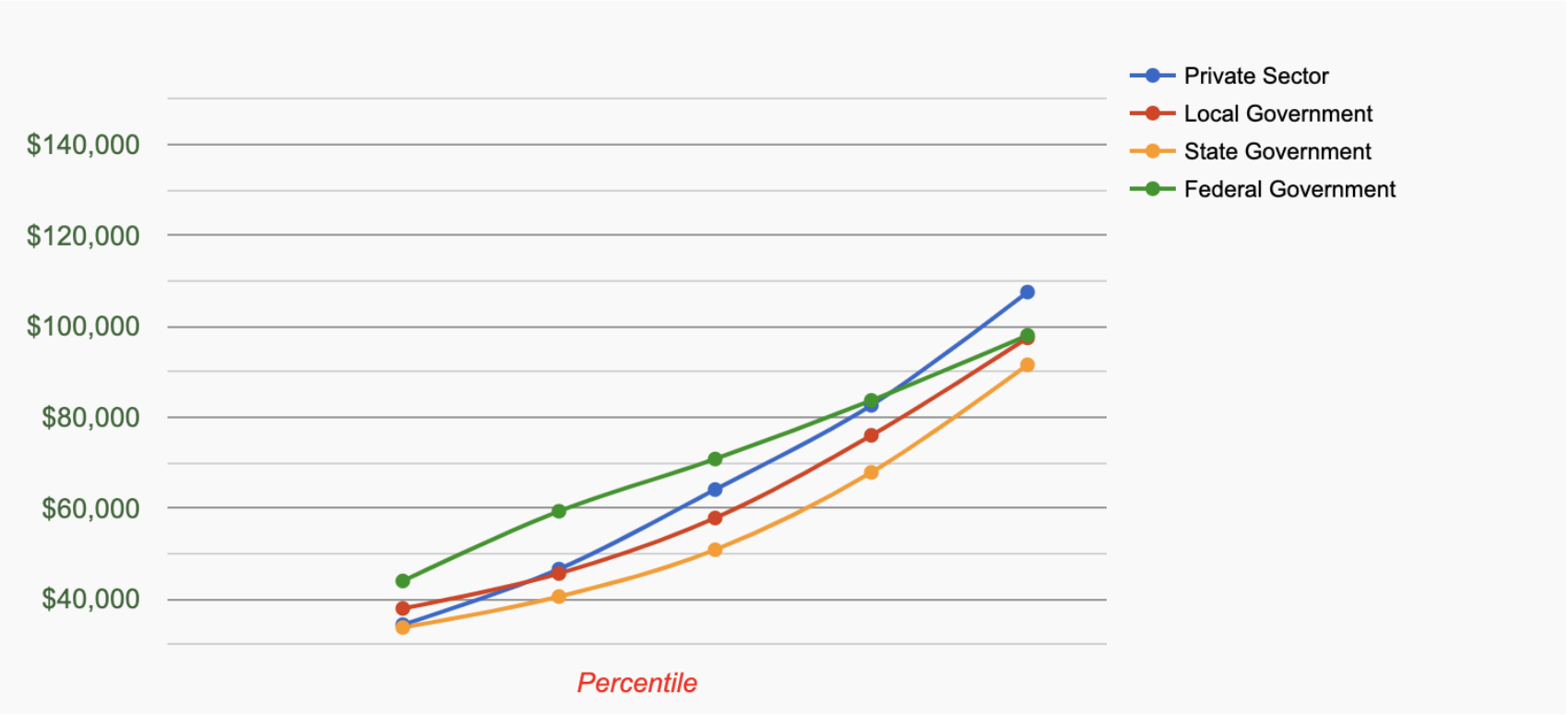
**Compensation & Benefits:** 3.6 ★
**Culture & Values:** 3.8 ★
**Career Opportunities:** 3.9 ★
**Work/Life Balance:** 3.4 ★

**Job & Company Insights**

**Job Type:** Full-time
**Job Function:** Bioinformatics Sc
**Industry:** Biotech & Pharmaceu
**Size:** 201 to 500 Employees

# Wages

## ANNUAL SALARY



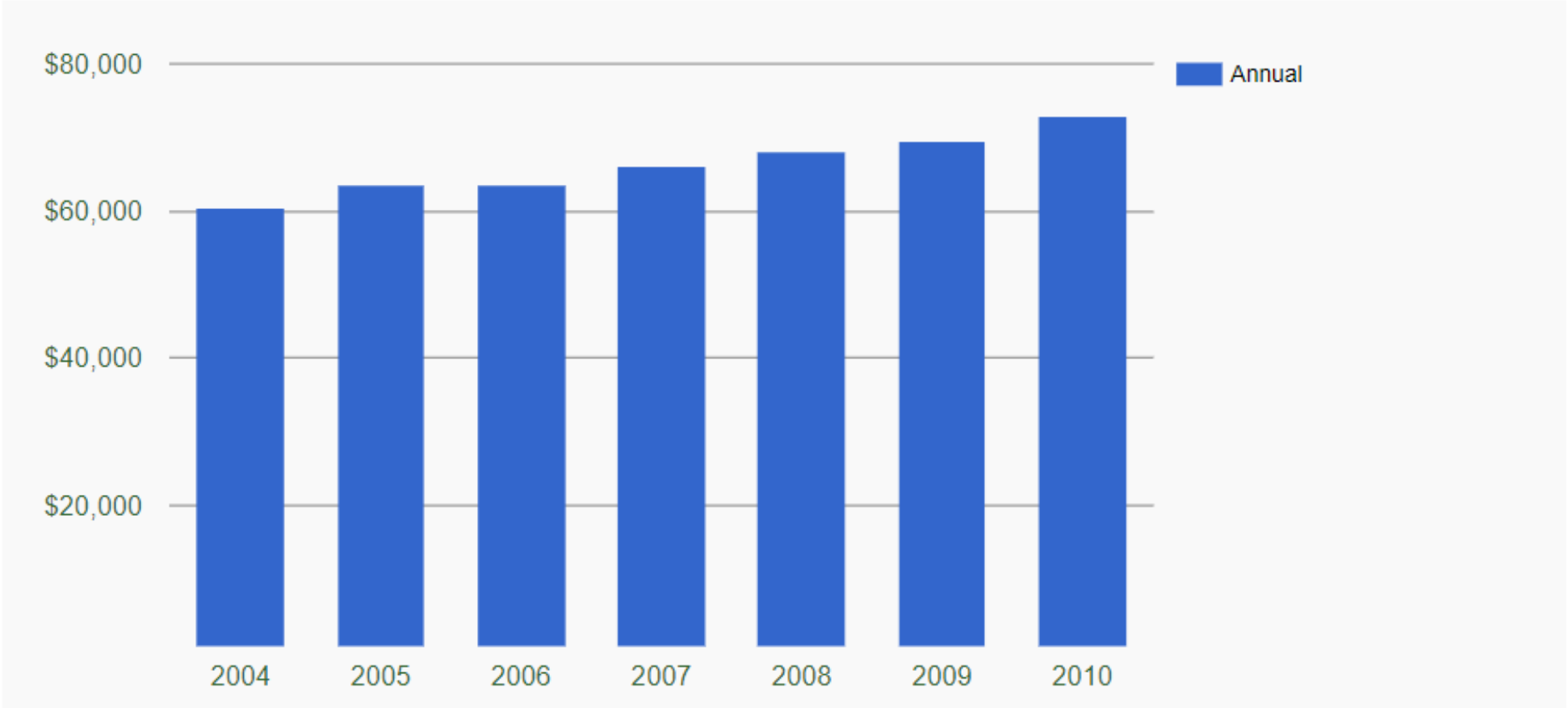

## HOURLY RATE

https://www.recruiter.com/salaries/bioinformatics-scientists-salary/

# Trends

## SALARY TREND

The annual compensation for this career has gone up since 2004. Salaries have increased by an average of 20.87 percent nationwide in that time.

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